

**NATURAL RESOURCES CONSERVATION SERVICE  
CONSERVATION PRACTICE STANDARD**

**POND SEALING OR LINING - FLEXIBLE MEMBRANE  
(NO.)**

**CODE: 521A**

**DEFINITION**

A manufactured hydraulic barrier consisting of a functionally continuous sheet of synthetic or partially synthetic, flexible material.

**PURPOSE**

To control seepage from water and waste impoundments for water conservation and environmental protection.

**CONDITION WHERE PRACTICE APPLIES**

On ponds and water storage structures that require treatment to control seepage rates within acceptable limits.

On waste storage and waste treatment facilities built in or of excavated earth, and which require treatment to prevent the migration of contaminants from the site.

**CRITERIA**

Structures to be lined shall have been constructed to meet all applicable NRCS standards. All inlets, outlets, ramps, and other apertures may be installed before, during, or after the liner placement, but shall be done in a manner that does not damage or impair the proper operation of the liner.

All flexible membranes shall be certified by the manufacturer to be suitable for the intended use.

Design of the flexible membrane shall be in accordance with manufacturer recommendations. All flexible membrane installations shall meet the material and installation requirements of the plans and specifications provided for each installation, and shall be certified by the installer.

<b>Minimum Criteria for Membranes</b>	
<b>Type</b>	<b>Limiting Parameter</b>
HDPE	40 mil thickness
LLDPE	40 mil thickness
PVC	30 mil thickness
GCL	0.75 lb./sq ft (bentonite)
EPDM	45 mil thickness

HDPE = High Density Polyethylene

LLDPE = Linear Low Density Polyethylene

PVC = Polyvinyl Chloride

GCL = Geosynthetic Clay Liner

EPDM = Synthetic Rubber

Select soil materials shall be used as cover for liners where required for the proper performance, protection, and durability of the installation. Cover soils shall not contain sharp, angular stones or any objects that could damage the liner. Maximum allowable particle size of soil cover material shall be 3/8-in (10 mm), unless the liner is cushioned by a needle punched, non-woven geotextile. Cover materials shall be stable under all operational and exposure conditions.

Subgrade preparation shall conform to manufacturer recommendations. Subgrade materials shall not contain sharp, angular stones or any objects that could damage the liner or adversely impact its function.

All structures shall be fenced to protect the liner from damage and for the safety of humans, livestock, wildlife, and pets.

Conservation practice standards are reviewed periodically, and updated if needed. To obtain the version of this standard, contact the Natural Resources Conservation Service. Contact Dan Baumert, NRCS State Conservation Engineer at 207-990-9555 or email comments and concerns to [dan.baumert@me.usda.gov](mailto:dan.baumert@me.usda.gov).

Manufacturer recommendations shall be followed with regard to protection from weather and exposure.

If venting is used, manufacturer recommendations shall be followed regarding vent type and spacing.

#### **CONSIDERATIONS**

Venting should be considered if gas build up under the liner is anticipated.

If high water tables could adversely affect the proper functioning of the facility, interceptor or relief type drainage systems should be considered to control uplift pressures.

#### **PLANS AND SPECIFICATIONS**

Plans and specifications shall be prepared for specific field sites in accordance with this standard and shall describe the requirements for applying the practice to achieve its intended uses.

#### **OPERATION AND MAINTENANCE**

A plan for operation and maintenance of the liner shall be prepared.

## NATURAL RESOURCES CONSERVATION SERVICE

### CONSTRUCTION SPECIFICATION

#### POND SEALING OR LINING - FLEXIBLE MEMBRANE

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#### **SCOPE**

The sealing or lining system shall be located as shown on the drawings or as staked or located in the field. Construction shall be to the lines and grades specified by the plans and shown on the drawings. Construction equipment and methods will be used to insure the system is installed according to the design and manufacturer's recommendations

#### **INSTALLATION**

All installation procedures will meet or exceed those recommended by the manufacturer. The following installation procedures shall also be met.

##### **Subgrade preparation**

The area to be lined shall be drained and allowed to dry until the surface is firm and can support the men and equipment that must travel over it during installation of the lining.

All banks and fills in the area to be lined must be sloped no steeper than 1 to 1 for exposed linings and 2 1/2 horizontal to 1 vertical for buried linings.

The foundation area for flexible membrane linings shall be smooth and free of projections that can damage the lining. Stumps and roots shall be removed. Rocks, hard clods, and other such material shall be removed, rolled so as to provide a smooth surface, or covered with a cushion of fine soil.

If needed, an effective sterilant shall be applied to the subgrade at the rate recommended by the manufacturer.

An anchor trench shall be excavated completely around the area to be lined at the planned elevation of the top of the lining. The trench shall be 8 to 10 in. (203 to 254 mm) deep and about 12 in (304 mm) wide.

All lining material shall be free of damage or defect. Each package delivered to the job site shall bear the name of the material, the manufacturer's name or symbol, the quantity therein, and the thickness or weight of the material.

##### **Placement**

Membranes shall be loosely spread over the subgrade. Polyethylene film requires about 5 percent slack for satisfactory results.

All field splies shall be made according to the manufacturer's recommended technique, using materials furnished for the purpose. The joints shall be watertight and capable of maintaining their integrity throughout the expected life of the lining.

Approximately 8 in. (203mm) of the top of the lining shall be placed in the anchor trench and anchored with compacted backfill.

For covered membranes, the material to be used as a protective cover shall be free of large clods, sharp rocks, sticks, and other objects that can puncture the lining. The cover shall be placed to the specified depth without damage to the membrane.

#### **MATERIALS**

All materials are to meet the requirements indicated in tables 1, 2, 3, 4, 5, and 6, as appropriate .

**TABLE 1 - REQUIREMENTS FOR POLYETHYLENE AND ETHYLENE CO-POLYMER PLASTIC FILM**

Test Description	Requirements		Test Method
	Type I Polyethylene	Type II Co-Polymer	
Tensile strength, each direction, minimum average.....lb/in <sup>2</sup>	1,800	2,000	ASTM-D-882, Method "A"
Ultimate elongation, each minimum average,.....pct	500	500	ASTM-D-882, Method "A"
Impact resistance, minimum average .....g/mil	45	65	ASTM-D-1709, Method "B"
Water vapor permeability .....perm-mil	0.7	1.5	ASTM-D-96
Tear resistance, each direction, minimum.....g/mil	80	80	ASTM-D-1922 ASTM-D-3083
Soil burial tensile strength change, each direction maximum..pct	5	5	ASTM-D-3083
Elongation loss, each direction, maximum.....pct	20	20	
Luminous transmittance, maximum.....pct	1.0	1.0	National Bureau of Standards Publications PS-17

**TABLE 2. REQUIREMENTS FOR REINFORCED RUBBER SHEETING  
REQUIREMENTS**

<b>Test Description</b>	<b>Up to 20 mil thick</b>	<b>20 mil thick and greater</b>	<b>Test Method</b>
Breaking strength, min			ASTM-D-751
Warp direction .....lb/in	75	100	
Fill direction.....lb/in	75	100	
Ultimate elongation, maximum			ASTM-D-751
Warp direction.....pct	30	30	
Fill direction.....pct	30	30	
Ozone resistance, procedure "B" 50 pphm			ASTM-D-1149
100 degrees.....days	7	7	ASTM-D-518
Hydrostatic strength, retained after ozone exposure, 7 days (Mullen).....pct	100	100	Federal Specs CCC 191 b, Method 5512 ASTM-D-518
Heating aging, 7 days at 212 degrees F			ASTM-D-573
Tensile strength ...pct retained	90	90	
Elongation .....pct retained	90	90	
Tear resistance, minimum, warp or fill direction..... lb.	8	8	ASTM-D-751, (tongue)
Hydrostatic burst (Mullen), min..... lb/in <sup>2</sup>	100	175	ASTM-D-751 1/
Dimensional stability, 7 days at 212 degrees F, change in length or width.....pct	+1.0	+1.0	
Low temperature, Flexible (optional) No cracking or flaking	-40F	-40F	Federal Specs CCC 191 b, Method 5874

Test Description	Up to 20 mil thick	20 mil thick and greater	Test Method
Commercial field splice strength shear force, minimum tensile.....pct	75	75	Commercial field splice 1-in-wide strip, pulled in shear at 10 in/min, after 7 days cure at room temperature.

1/ A 1-ft<sup>2</sup> sample, 10-in. bench marks in warp and fill direction, placed on aluminum or stainless plate in changing air over.

**TABLE 3. REQUIREMENTS FOR UNREINFORCED RUBBER SHEETING REQUIREMENTS**

Test Description	Type A	Type B	Test Method
Tensile strength, min .....lb/in <sup>2</sup>	1,200	1,200	ASTM-D-412
Modulus at 300% elongation, minimum..lb/in <sup>2</sup>	600	600	ASTM-D-412
Ultimate elongation, min.....pct	300	300	ASTM-D-412
Shore "A" hardness ozone resistance, procedure "A"	60+10	60+10	ASTM-D-2240 ASTM-D-1149
No cracks, 50 pphm at 100F 20% elongation .....days	7		
No cracks, 100 pphm at 100F 50%, elongation .....days			ASTM-D-518
Heat aging, 7 days at 212F			ASTM-D-573
Tensile strength retained.....pct	75	75	
Elongation retained.....pct	75	75	
Water vapor permeability at 80F max.....perm mil	0.002	0.05	ASTM-E-96, procedure BW

Test Description	Type A	Type B	Test Method
Tear resistance, min. .....lb/in2	150	150	ASTM-D-624 Die "B"
Dimensional stability, 7 days at 212F, change in length of width.....pct	+0.5	+0.5	
Commercial field splice Strength 60 shear force, minimum tensile.....pct	60	60	Commercial splice, 1-in wide strip pulled in shear at 10 in/min, after 7 day cure at room temp.

**TABLE 4 – REQUIREMENTS OF POLYVINYL CHLORIDE PLASTIC SHEETING**

Test Description	Requirements	Test Method
Tensile, strength, each direction, minimum average.....1b/in2	2,000	ASTM-D-882
Elongation at break min.....pct	250	ASTM-D-882 Method A
Volatile loss, max.....pct	0.7	ASTM-D-1203 Method A
Water extraction, Max weight loss.....pct	0.5	ASTM-D-1239
Tear resistance, each direction, min.....g/mil	160	ASTM-D-1922
Resistance to soil burial (percent change max in Breaking factor.....pct	-5	ASTM-D-3083 (120 days soil orig. value burial)
Elongation at break.....pct	-20	
Modulus at 100% Elongation.....pct	+10	
Bonded seem strength percent Breaking factor.....pct	80	ASTM-D-3083 Para. 9.3 (1 in. width)

**TABLE 5 – UNREINFORCED CHLORISULFONATED POLYETHYLENE**

<b>Test Description</b>	<b>Minimum Requirements</b>	<b>Test Method</b>
Tensile strength, minimum psi.....pct	1,000	ASTM-D-412
Ultimate elongation, minimum.....pct	250	ASTM-D-412
Ozone resistance, 50 pphm, 20% drain, 100F, 8000 hrs.....pct	+0	ASTM-D-1149
Heat aging, 14 days at 212F		ASTM-D-412
Tensile strength, min psi.....pct	1,000	
Elongation at break.....pct	150	
Tear resistance, min.....lb/in.	250	ASTM-D-624, Die B
Commercial field splice strength, 882, shear force, minimum tensile.....pct	60	ASTM-D-
Weight change after 7 days at 70c in water, maximum.....pct	5	ASTM-D-471

**TABLE 6 – REINFORCED CHLORISULFONATED POLYETHYLENE**

<b>Test Description</b>	<b>Minimum Requirements 30 mils thick and greater</b>	<b>Test Method</b>
Breaking strength, min		ASTM-D-751
Rubber.....lb/in.	100	
Fabric.....lb/in	75	
Ultimate elongation, max		ASTM-D-751
Rubber.....pct	150	
Fabric.....pct	20	
Ozone resistance, 50 pphm, 20% strain at 100F 8000 hrs.....pct	+0	ASTM-D-1149
Hydrostatic strength after ozone exposure 7 days (Mullen), % retained.....pct	100	Federal Specs CCC 191b Method 5512



Test Description	Minimum Requirements 30 mils thick and greater	Test Method
Heat aging, 14 days at 212F of original Tensile strength.....pct Elongation % retained of original.....pct	90   90	ASTM-D-518
Tear resistance, lbs.min warp or fill direction.....pct	10	ASTM-D-751
Puncture resistance, lbs. minimum.....pct	120	FTMS 101B, Method 2031
Commercial field splice Strength-shear force % of min. break.....pct	75	ASTM-D-882, 7 days cure